

## CLAIMS

### WHAT IS CLAIMED IS:

1. A method of fabricating a support structure, comprising:  
forming a plurality of pores through a substrate; and  
actively controlling a shape or size of said pores formed through said substrate.
2. The method of claim 1, wherein said controlling a shape of said pores comprises forming pores having a diameter that varies along a length of the pore through said substrate.
3. The method of claim 1, wherein said controlling a shape of said pores comprises forming pores that each comprise a surface opening and a narrower opening interior to said substrate wherein said pore tapers inward from said surface opening to said narrower opening.
4. The method of claim 1, wherein said controlling a shape or size of said pores comprises modulating a voltage applied during formation of said pores.
5. The method of claim 4, wherein said modulating said applied voltage comprises:  
selecting a selected voltage based on a desired size of said pores; and  
maintaining said applied voltage at said selected voltage.
6. The method of claim 4, further comprising:  
selecting a desired shape for said pores; and  
modulating said applied voltage in accordance with said desired shape for said pores.

7. The method of claim 6, wherein said modulating said applied voltage comprises applying a first voltage for a first time period, applying a second voltage for a second time period, said second voltage being lower than said first voltage, and applying a third voltage for a third time period wherein said third voltage is lower than said second voltage.

8. The method of claim 6, wherein said modulating said applied voltage comprises applying a first voltage for a first time period, applying a second voltage for a second time period, said second voltage being lower than said first voltage, and applying a third voltage for a third time period wherein said third voltage is higher than said second voltage.

9. The method of claim 1, further comprising creating secondary porosity in said substrate.

10. The method of claim 1, further comprising annealing said substrate.

11. The method of claim 1, further comprising selectively micro-machining said substrate.

12. The method of claim 11, wherein said micro-machining comprises defining a plurality of channels in said substrate.

13. The method of claim 11, wherein said micro-machining comprises anisotropic anodization.

14. The method of claim 11, wherein said micro-machining comprises local anodization.

15. A method of fabricating a fuel cell support structure, comprising:  
forming a plurality of pores through a substrate; and

actively controlling a shape or size of said pores formed through said substrate.

16. The method of claim 15, wherein said controlling a shape of said pores comprises forming pores having a diameter that varies along a length of the pore through said substrate.

17. The method of claim 15, wherein said controlling a shape of said pores comprises forming pores that each comprise a surface opening and a narrower opening interior to said substrate wherein said pore tapers inward from said surface opening to said narrower opening.

18. The method of claim 15, wherein said controlling a shape or size of said pores comprises modulating a voltage applied during formation of said pores.

19. The method of claim 18, wherein said modulating said applied voltage comprises:

- selecting a selected voltage based on a desired size of said pores; and
- maintaining said applied voltage at said selected voltage.

20. The method of claim 18, further comprising:

- selecting a desired shape for said pores; and
- modulating said applied voltage in accordance with said desired shape for said pores.

21. The method of claim 20, wherein said modulating said applied voltage comprises applying a first voltage for a first time period, applying a second voltage for a second time period, said second voltage being lower than said first voltage, and applying a third voltage for a third time period wherein said third voltage is lower than said second voltage.

22. The method of claim 20, wherein said modulating said applied voltage comprises applying a first voltage for a first time period, applying a second voltage for a second time period, said second voltage being lower than said first voltage, and applying a third voltage for a third time period wherein said third voltage is higher than said second voltage.

23. The method of claim 15, further comprising creating secondary porosity in said substrate.

24. The method of claim 15, further comprising annealing said substrate.

25. The method of claim 15, further comprising selectively micro-machining said substrate.

26. The method of claim 25, wherein said micro-machining comprises defining a plurality of channels in said substrate.

27. The method of claim 25, wherein said micro-machining comprises anisotropic anodization.

28. The method of claim 25, wherein said micro-machining comprises local anodization.

29. A method of forming a fuel cell, comprising:  
forming a plurality of pores through a substrate;  
actively controlling a shape or size of said pores formed through said substrate; and  
forming an electrolyte, an anode, and a cathode on said substrate.

30. The method of claim 29, wherein said controlling a shape of said pores comprises forming pores having a diameter that varies along a length of the pore through said substrate.

31. The method of claim 29, wherein said controlling a shape of said pores comprises forming pores that each comprise a surface opening and a narrower opening interior to said substrate wherein said pore tapers inward from said surface opening to said narrower opening.

32. The method of claim 29, wherein said controlling a shape or size of said pores comprises modulating a voltage applied during formation of said pores.

33. The method of claim 32, wherein said modulating said applied voltage comprises:

- selecting a selected voltage based on a desired size of said pores; and
- maintaining said applied voltage at said selected voltage.

34. The method of claim 32, further comprising:

- selecting a desired shape for said pores; and
- modulating said applied voltage in accordance with said desired shape for said pores.

35. The method of claim 34, wherein said modulating said applied voltage comprises applying a first voltage for a first time period, applying a second voltage for a second time period, said second voltage being lower than said first voltage, and applying a third voltage for a third time period wherein said third voltage is lower than said second voltage.

36. The method of claim 34, wherein said modulating said applied voltage comprises applying a first voltage for a first time period, applying a second voltage for a second time period, said second voltage being lower than said first voltage, and applying a third voltage for a third time period wherein said third voltage is higher than said second voltage.

37. The method of claim 29, further comprising creating secondary porosity in said substrate.

38. The method of claim 29, further comprising annealing said substrate.

39. The method of claim 29, further comprising selectively micro-machining said substrate.

40. The method of claim 39, wherein said micro-machining comprises defining a plurality of channels in said substrate.

41. The method of claim 39, wherein said micro-machining comprises anisotropic anodization.

42. The method of claim 39, wherein said micro-machining comprises local anodization.

43. A system of fabricating a fuel cell support structure, comprising:  
means for forming a plurality of pores through a substrate; and  
means for actively controlling a shape or size of said pores formed through said substrate.

44. The system of claim 43, wherein said means for controlling a shape of said pores comprises means for forming pores having a diameter that varies along a length of the pore through said substrate.

45. The system of claim 43, wherein said means for controlling a shape of said pores comprises means for forming pores that each comprise a surface opening and a narrower opening interior to said substrate, wherein said pore tapers inward from said surface opening to said narrower opening.

46. The system of claim 43, wherein said means for controlling a shape or size of said pores comprises means for modulating a voltage applied during formation of said pores.

47. The system of claim 46, wherein said means for modulating said applied voltage comprises:

means for selecting a selected voltage based on a desired size of said pores; and

means for maintaining said applied voltage at said selected voltage.

48. The system of claim 46, further comprising:

means for selecting a desired shape for said pores; and

means for modulating said applied voltage in accordance with said desired shape for said pores.

49. A fuel cell comprising:

a support substrate supporting a cathode, anode and electrolyte; and

a plurality of pores formed through said substrate, said pores having a size and shape formed in accordance with a pre-selected desired porosity.

50. The fuel cell of claim 49, wherein said electrolyte is deposited in said pores.

51. The fuel cell of claim 49, wherein said pores vary in diameter along a thickness of said substrate.

52. The fuel cell of claim 49, wherein said pores branch within said substrate.

53. The fuel cell of claim 49, wherein branching of said pores results in a greater number of pore openings on a first side of said substrate than on a second side of said substrate.

54. The fuel cell of claim 53, wherein said anode is disposed on said first side of said substrate and said cathode is disposed on said second side of said substrate.

55. The fuel cell of claim 49, wherein said substrate comprises a ceramic.

56. The fuel cell of claim 49, wherein said substrate comprises alumina.

57. The fuel cell of claim 49, wherein said substrate comprises a second plurality of pores formed through said substrate wherein an average size of said second plurality of pores is smaller than said first plurality of pores.

58. An apparatus comprising:

a power-consuming device;

a fuel cell providing power to said device, said fuel cell comprising:

a support substrate supporting a cathode, anode and electrolyte;

and

a plurality of pores formed through said substrate, said pores having a size and shape formed in accordance with a pre-selected desired porosity.

59. The apparatus of claim 58, wherein said electrolyte is deposited in said pores.

60. The apparatus of claim 58, wherein said pores vary in diameter along a thickness of said substrate.

61. The apparatus of claim 58, wherein said pores branch within said substrate.



62. The apparatus of claim 61, wherein branching of said pores results in a greater number of pore openings on a first side of said substrate than on a second side of said substrate.

63. The apparatus of claim 62, wherein said anode is disposed on said first side of said substrate and said cathode is disposed on said second side of said substrate.

64. The apparatus of claim 58, wherein said pores are formed in parallel through said substrate.

65. The apparatus of claim 58, wherein said substrate comprises a ceramic.

66. The apparatus of claim 58, wherein said substrate comprises alumina.

67. The apparatus of claim 58, wherein said substrate comprises a second plurality of pores formed through said substrate wherein an average size of said second plurality of pores is smaller than said first plurality of pores.